
विधुत नमी मीटर — विशिष्टि

भाग 1 खाद्यान्न, बीज और आटा
(पहला पुनरीक्षण)

**Electrical Moisture Meters —
Specification**
Part 1 Food Grains, Seeds And Flour
(First Revision)

ICS 67.260

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Agriculture and Food Processing Equipment Sectional Committee had been approved by the Food and Agriculture Division Council.

Moisture meter is used for measuring the moisture present in the grains. Based on the moisture percentage the farmers get the price for their produce. This is mainly used by the procuring agencies in the *mandis*. Electrical moisture meters are a direct, quick and convenient means of determining the moisture content. Electrical moisture meters are commonly used for determination of moisture content of materials, such as foodgrains, cereals, oil seeds and pulses. Variety of designs of reliable instruments are available for making spottests of these materials.

This standard was first published in 1978. The first revision has been taken up to keep pace with the latest technological developments and international practices. In this revision following major changes have been made:

- a) The scope has been modified;
- b) Terminologies has been updated;
- c) Measurement uncertainty range has been provided; and
- d) Construction features with material table has been provided.

The standard is issued in two parts. The second part of the standard is as under:

Part 2 For jute (conductivity type)

The composition of the Committee responsible for the formulation of this standard is placed at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
ELECTRICAL MOISTURE METERS — SPECIFICATION
PART 1 FOOD GRAINS, SEEDS AND FLOUR

(*First Revision*)

1 SCOPE

This standard specifies the requirements and test method for electrically-operated and battery-operated moisture meters used for the determination of moisture content of food grains like cereals, pulses, oil seeds, vegetable seeds, fodder seeds and other granular agricultural produce like coffee beans, oats grain and various types of flours.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

<i>IS No.</i>	<i>Title</i>
IS 4333 (Part 2) : 2017/ISO 719 : 2009	Methods of analysis for foodgrains: Part 2 Determination of moisture content (<i>second revision</i>)

3 TERMINOLOGY

3.0 For the purpose of this standard the following definitions shall apply.

3.1 Accuracy

Accuracy is the ability of the instrument to measure the accurate value. In other words, it is the closeness of the measured value to a standard or true value.

3.2 Compression Unit

The device used to compress grains/seeds/flour (to bring it to a uniform state and to minimize the porosity effect).

3.3 Electrical Moisture Meter

The type of moisture meter which works on the

principle of electrical output such as change in resistance, capacitance and inductance.

3.4 Electrode

An electrical conductor used to make contact with the non-metallic circuit part of a circuit.

3.5 Flour

A very thin powder made from grains/seeds.

3.6 Grain

The small, hard and dry seed harvested for human or animal consumption.

3.7 Moisture Meter

The instrument to measure the moisture content of the grains/seeds.

3.8 Oil Seed

The kernel seeds extracted from crops yielding oil.

3.9 Probe

A physical device connecting to the electronic measuring instrument which is used to measure the parameters to be tested.

3.10 Ratchet Mechanism

The mechanism used for grains/seeds/flour compression and slips when desired compression is achieved.

3.11 Repeatability

Precision in measurements under conditions that include the same measurement procedure, same operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time.

3.12 Seed

The agricultural grains having standard germination ability and varietal genetic purity to give rise to Agricultural plants and used for multiplication of

varietal identity plants.

3.13 Test Cup

Container for grains/seeds/flour whose moisture percentage is to be tested.

3.14 Thermo Gravimetric Principle

The weight loss of mass that occurs as the material is heated. The sample weight is taken prior to heating and again after reaching a steady-state mass subsequent to drying.

3.15 Uncertainty

The expression of the statistical dispersion of the values attributed to a measured quantity.

4 TYPES

4.0 Depending upon the operating principles, the electrical moisture meters shall be one of the following types:

- a) Type 1 — Conductivity/Resistance type moisture meters
- b) Type 2 — Capacitance/Dielectric type moisture meters.

4.1 Type 1 — Conductivity/Resistance Type Moisture Meters

4.1.1 Portable Model

These conductivity meters are used for measuring moisture at field level (in situ measurement), as it is easier to carry the moisture meter by single person. The volume of sample in conductivity/resistance meters shall be minimum of 10 cm³. The test cup shall be of non-corrosive material. As per the design of manufacturer, if required moisture meter should also have special facility to grind the sample of seeds/grains without appreciable development of heat. In order to minimise the porosity effect the sample shall be compressed.

4.1.2 Table Top Model

These meters are used as stationary meters in the laboratory/procurement/storage centre to measure moisture in the grains. The test cup shall be of non-corrosive material. The volume of sample shall be minimum of 10 cm³. As per the design of manufacturer, if required moisture meter should also have special facility to grind the sample of seeds/grains without appreciable development of heat. In order to minimise the porosity effect the sample shall be compressed.

4.2 Type 2 — Capacitance/Dielectric Type Moisture Meters

4.2.1 Portable Model

These moisture meters are used in in-situ environment.

4.2.2 Table Top Model

These meters are used as stationary meters in the laboratory/procurement/storage centre to measure moisture in the grains.

5 OPERATING PRINCIPLES

5.1 Conductivity/Resistance Type Moisture Meters

These meters work on the principle of electrical conductivity of the material. The electrical conductivity is dependent on the moisture content of the material, which is subjected to compression in test cup (as per the recommendation of the manufacturer). Moisture is determined by the measurement of electrical conductance of the sample when it is held in a test cup/electrode vessel.

5.2 Capacitance Type Moisture Meter

The basic operating principle of the capacitance type meter is based on the change occurring in the dielectric constant of a material, between its moist and dry condition. Moisture is determined by the measure of capacitance of the sample. The sample size in such meters shall be precise by either volume or weight (preferably by weight) based on the manufacturers design. Grains shall not be less than 250 g (wheat basis) loaded in measurement cell. The measuring frequency and amplitude shall be stabilized. The stabilization circuits shall be provided to make stable and sound moisture measurement with minimum variation. The temperature of the grain shall be measured precisely. Uniform feeding is required to these meters for accurate measurement of moisture of grains. This requires a minimum distance of at least 25 mm to allow the crops to fall evenly in the measuring cell.

6 GENERAL AND CONSTRUCTIONAL REQUIREMENTS

6.1 General

Moisture Meters shall be sturdy and compact.

6.2 Temperature Compensation

Moisture Meters shall have a built-in temperature compensation circuit to avoid the error due to ambient temperature change. The stabilization circuit is provided to make stable and sound moisture measurements without variation with temperature of samples.

6.2.1 Initial Grain Calibrations

The manufacturers initial setting of grain calibrations need to be made with reference method traceable to national standards. The calibration tables in the meter shall be made against reference method at moisture intervals of around 2 per cent by the manufacturer or his authorized lab at $24 \pm 2^\circ\text{C}$ and relative humidity (30-70) percent under laboratory condition. Manufacturer shall have an in-house moisture testing lab as per reference method and its instruments shall be traceable to national metrological lab. The reference method shall be standard oven method as per IS 4333 (Part 2).

6.2.2 Routine Calibration/Readjustments

The electrical moisture meter shall be provided with an arrangement for readjusting the readings to initial set readings. This may be done using standard resistance box, capacitance box/multi meters may be traceable to national standard or dedicated jigs etc. These electrical moisture meter may also be calibrated using reference material. Standardized readjustments are those physical adjustments or software parameters, which make the meter respond identically to the initial settings of the grains being measured. This may be done in the field without possibility of tempering.

In case verification of initial calibration with reference method is required than it shall be done at most common moisture content percentage for the most used grain in a controlled lab at $24 \pm 2^\circ\text{C}$.

6.2.3 Additional/Updation of Calibration

The calibrations tables may change due to changes in electrical characteristic of crops with change in crop variety or crop year or the area they come from. In case there is a need to make new tables, the meter shall have a provision to re-program calibration tables made with reference method by the manufacturer or his authorized lab. This does not preclude the possibility of the operator doing the calibration under the instruction of the manufacturer as per his procedure, however ensuring calibration security.

6.3 Display

Moisture Meters shall have a facility to show percentage of moisture content with a least count of 0.1%, temperature, date, time and crop name on a wirelessly connected smart device or in a built-in

system. It may have customer name, location, truck number, lot number etc.

6.3.1 Data Storage

Provision shall be there to store the above information on cloud server safely and securely to give facility to see data remotely and avoid any manipulation of results.

6.4 Supply Voltage

The Moisture Meters shall be designed for operation either on DC source, battery, AC supply or rechargeable battery. Manufacturer shall describe its safe applicable limit. There shall be low battery indication for error free measurement.

6.5 Accessories

The required accessories for operating the moisture meters shall be provided by the manufacturer. In the resistance/capacitance type moisture meter, volume cup, handle, adapter, battery, cleaning brush etc. shall be provided. In table top capacitance type moisture metre weighing scale shall be provided in case it does not have a built-in scale.

NOTE – Battery will be optional for export purpose and battery specification to be provided in view of transportation constraint.

6.6 Carrying Case

The meter shall be provided with a suitable carrying case. It shall also accommodate all the accessories.

6.7 Record of initial calibration data shall be maintained with the manufacturer. The manufacturers shall keep the record of the variety used and also need to maintain the relevant samples for a period of two months from the date of initial calibration. All equipment used by manufacturer shall be traceable to national standards.

6.8 The ground or ungrounded sample is compressed (to bring it to a uniform state and to minimize the porosity effect on the electrical conductivity), placed under the plunger and insulated test cup both of which act as electrodes or as per recommendation of the manufacturer. A constant mass/volume of material is taken and compressed as per manufacturer design. As per the design of the manufacturer if required, a suitable mechanism for grinding without much generation of heat shall be provided.

6.9 Constructional Features of Conductivity/Resistance Type Moisture Meter

Conductive type moisture meter employs a

compression unit and two electrode plates for measurement of sample resistance. This is detailed in 6.9.1 and in Fig.1. The electronics is elaborated in 6.9.3. The sample volume and stabilize measuring voltage affect the measurements.

6.9.1 Compression Unit

The compression unit shall be able to withstand compression for all grains/seeds/flour for which the moisture meter is calibrated. The test cup shall be a combination of metal and suitable insulation

material like plastic. The volume of sample shall be minimum 10 cubic centimetres. There shall be an indication for the customer to know that compression has been achieved. It shall have an arrangement for compression of all crops as per manufacturer's design. An indicative list of raw materials for different parts of compression unit is listed in Table 1.

Table 1 Raw Material for Different Parts of Compression Unit
(Clause 6.9.1)

Sl No. (1)	Compression Unit Parts (2)	Material (3)
i)	Body/Housing	Metal/any other suitable strong material like glass filled plastic
ii)	Test Cup	Combination of metal and suitable insulation material like plastic
iii)	Plunger	Metal

6.9.1.1 Power source

DC adapter/batteries as specified by the manufacturer.

6.9.2 A typical arrangement of conductivity moisture meter or as per manufacturer design is shown in Fig. 1.

6.9.3 Electronic/Electrical Unit

The electronic printed circuit board (PCB) is provided in the moisture meter body to measure the conductivity, temperature and any other required parameters with precision and transfer data to mobile device wirelessly.

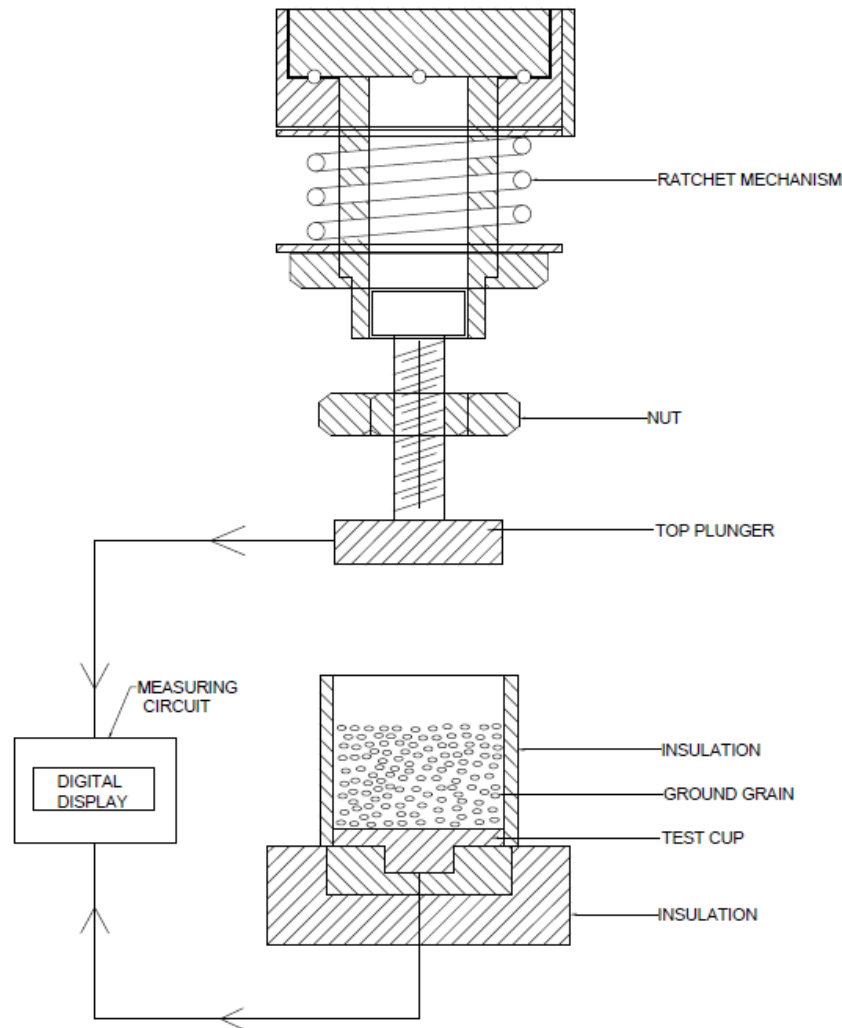


FIG. 1 TYPICAL ARRANGEMENT OF GRAIN MOISTURE METER (CONDUCTIVITY TYPE)

6.10 Constructional Features for Capacitance Type Moisture Meter

Capacitance type moisture meter employ two parallel/cylindrical plates with sample between them to act as dielectric. This is detailed in 6.10.1 and Fig. 2. Sufficient mass/volume of sample and stabilized signal is required for accurate measurement as elaborated in 6.10.3.

6.10.1 Measurement cell is made of two conducting parallel/cylindrical plates for measuring dielectric constant. Grains shall not be less than 250 g (wheat basis) loaded in measurement cell. The uniform feeding mechanism shall be present for measurement of accurate moisture of grains. A minimum distance of at least 25 mm uniformly along the length of measuring cell shall be present, to allow the crops to fall evenly in the measuring cell. Weighing is must in table top model and it can be integrated or provided separately to load a defined mass of sample depending on the density of

crop. In the table top model suitable mechanism shall be provided for loading and unloading of the sample in the measurement cell.

6.10.1.1 Power sources

Mains operated 230 V AC \pm 10 V or DC adapter/batteries as per specification provided by the manufacturer.

6.10.2 A typical arrangement of Capacitance Type moisture meter is shown in Fig. 2.

6.10.3 Electronic/Electrical Unit

The electronic printed circuit board (PCB) shall be provided in the moisture meter body to measure the dielectric constant, temperature and any other required parameters with precision and transfer data provision to mobile or any suitable electronic device as per the recommendation of manufacturer.

6.11 The moisture meter shall be so designed as to perform satisfactorily from 10 to 40°C continuously and at a maximum humidity of 30-70 percent. The storage temperature range shall be 0 to 55°C at maximum relative humidity of 90 percent.

NOTE – An appropriate error message should be displayed/conveyed when the moisture meter is outside the range of temperature.

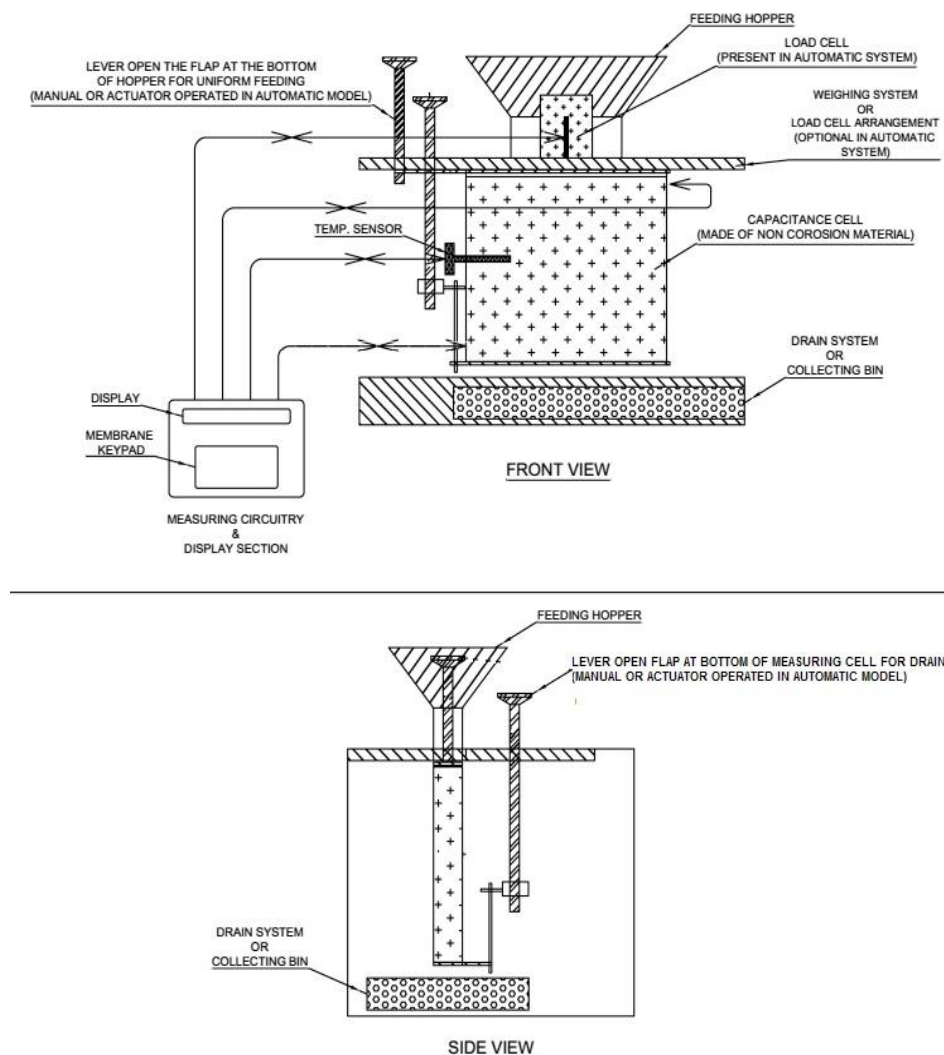


FIG. 2 TYPICAL ARRANGEMENT OF GRAIN MOISTURE METER (CAPACITANCE CELL)

7 TEST RESULTS

7.1 Repeatability Measurement

7.1.1 Method to Verify Repeatability — Repeat measurements with same source, operator, equipment procedure and environmental conditions within a short period (preferably within 3 hours) of time for minimum three replications. Calculate standard deviation of the measured data.

7.1.2 The repeatability of the test result shall be as below, if $0.02 \times M < 0.2$ then $\pm 0.2\%$, else it shall be $\pm 0.02 \times M$ (M is moisture percent).

Readings have to be taken within shortest period of time on the same moisture meter and same type of commodity. Standard deviation of the readings is

called as repeatability.

7.2 Uncertainty Measurement

7.2.1 The measurement uncertainty of the moisture meters shall be checked at $24 \pm 2^\circ\text{C}$ under laboratory condition. For different grains the accuracy shall be as below when compared with the reference method. If $0.04 \times M < 0.5$ then $\pm 0.5\%$, else it shall be $\pm 0.04 \times M$ (M is moisture percent) or as declared by the manufacturer depending on the commodity type (M is moisture percent).

8 MEASURING RANGE

The measuring range of moisture shall be from 4 to 40 percent depending upon crop type. The

measuring range shall be declared by the manufacture crop wise.

9 PACKING AND MARKING

9.1 Packing

The moisture meter shall be packed in suitable container in which it could conveniently and safely be transported.

9.2 Marking

9.2.1 The Display plate of the moisture meter shall be clearly and indelibly marked with the following information:

- a) Manufacturer's name or trade mark;
- b) Type of Meter (*see* 4) ;
- c) Model, if any;
- d) Serial number;
- e) Supply voltage (to be declared by the manufacturer);
- f) Country of manufacture; and
- g) Contact address, Customer care number and email.

9.2.2 The manufacturer shall provide a manual which shall have information regarding the moisture percentage range for various crops in the measuring range of moisture content that can be determined by the moisture meter. The manual shall also cover all the necessary precautions and operating instructions for all types of conductivity and capacitance type moisture meter.

9.3 BIS Certification Marking

The moisture meter may also be marked with the Standard Mark.

9.3.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A
(Foreword)

COMMITTEE COMPOSITION

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